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(54) **METHOD AND APPARATUS FOR SELECTING PATH**
VERFAHREN UND VORRICHTUNG ZUR AUSWAHL EINES PFADES
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(73) Proprietor: **Huawei Technologies Co., Ltd.**
Longgang District
Shenzhen, Guangdong 518129 (CN)

(72) Inventors:
- **DING, Xiaojian**
  Shenzhen
  Guangdong 518129 (CN)
- **WU, Qin**
  Shenzhen
  Guangdong 518129 (CN)

(74) Representative: **MERH-IP Matias Erny Reichl Hoffmann**
Patentanwälte PartG mbB
Paul-Heyse-Strasse 29
80336 München (DE)

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Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relate to the field of communications technologies, and in particular, to a path selection method and apparatus.

BACKGROUND

[0002] In an existing network, a path computation element (Path Computation Element, PCE for short) may compute a best path of a service based on a request of a path computation client (Path Computation Client, PCC for short). Specifically, if a path needs to be computed for a service, the PCC sends a path computation request to the PCE, and when the PCE receives the path computation request from the PCC, the PCE computes, by using existing network topology information, an end-to-end path that meets a constraint condition and a policy of the service. The PCE may obtain, through computation, a same path for different services. Because one path can be used for a plurality of services, and a latency of the path is affected by a quantity of services that use the path, the PCE cannot determine the latency of the path.

[0003] Most services have specific latency requirements. When the PCE cannot determine a latency of a path, the PCE cannot ensure that a path allocated to a service can meet a latency requirement of the service.

[0004] Document US2017/0064717A1 discloses a network element (in a network) that controls, within another network, the constraints of a service, timing of the creation of the service, and selection a service on which a packet is transmitted. A first network element controls creation of the service in the first network on behalf of a second network element located in a second network by, e.g., identifying a path based, at least in part, on the at least one path constraint; and binding an identifier and an interface to the path, wherein the interface is associated with one or more operation to perform on any traffic that is labeled with the identifier.

[0005] Document "Applicability of the Path Computation Element to Inter-Area and Inter-AS MPLS and GMPLS Traffic Engineering" by Q. Zhao, D. Dhdoy Huawei et al. discloses the definition of an explicit and a loose path in a network topology. Further the determination of a path with strict QoS constraints is described. The publication "PACKET FORWARDING ALONG AN EXPLICIT ROUTE USING THE UNUSED ADDRESS POOL ON A PACKET SWITCHING NETWORK" by MAIZUMI H ET AL:, (2007-09-01), pages 78-89, XP001542559 discloses a method in which unused addresses are used as labels for packet flows with various granularities, which are transferred along explicitly specified routes.

SUMMARY

[0006] The present invention provide a path selection method and apparatus, so as to resolve a problem that a PCE cannot ensure that a path allocated to a service can meet a latency requirement of the service.

[0007] The following technical solutions are used in the present invention to achieve the foregoing objective. This invention is defined by the appended claims.

[0008] According to a first aspect, a path selection method is provided, where the method includes: obtaining a required latency of a service; and determining a target path for the service from m strict explicit paths based on the required latency, where a latency of the target path is less than or equal to the required latency, all the m strict explicit paths are unallocated paths, any subpath of a first strict explicit path in the m strict explicit paths exists in only the first strict explicit path, the first strict explicit path is any path in the m strict explicit paths, and m is an integer greater than or equal to 1.

[0009] According to the method provided in the first aspect, because any two paths do not include a same subpath and a path is allocated to only one service, a latency of each path is determined. When the path is determined for the service, the determined latency of the path is less than or equal to the required latency of the service, so that the path determined for the service can meet a latency requirement of the service, and an experience effect of a user is improved.

[0010] In a possible design, before the determining a target path for the service from m strict explicit paths based on the required latency, the method further includes: determining a loose path corresponding to the service; and determining the m strict explicit paths based on unallocated network slices in network slices of n subpaths of the loose path, where a second strict explicit path in the m strict explicit paths includes n network slices, the n network slices are respectively corresponding to the n subpaths, a first network slice in the n network slices is an unallocated network slice in network slices of a subpath corresponding to the first network slice, the second strict explicit path is any path in the m strict explicit paths, the first network slice is any network slice in the n network slices, and n is an integer greater than or equal to 2.

[0011] In the possible design, the m strict explicit paths can be determined for the service, and it can be ensured that any subpath of the first strict explicit path in the determined m strict explicit paths exists in only the first strict explicit path.

[0012] In a possible design, after the determining the m strict explicit paths based on unallocated network slices in network slices of n subpaths of the loose path, the method further includes: determining a latency of each of the m strict explicit paths, where a latency of a third strict explicit path in the m strict explicit paths is a sum of latencies of all network slices that constitute the third strict explicit path, and the third strict explicit path is any path in the m strict explicit paths.

[0013] In the possible design, the latencies of the m strict explicit paths can be determined for the service, so that the target path is subsequently determined for the service.

[0014] In a possible design, the determining a target path for the service from m strict explicit paths based on the required latency includes: determining a priority of the service; determining available paths for the service from the m strict explicit paths based on the required latency, where a latency of each of the available paths is less than or equal to the required latency; and determining the target path from the available paths based on the priority.

[0015] In this possible design, when the priority of the service is a high priority, a path with a relatively low latency in the available paths is determined as the target path; or when the priority of the service is a normal priority, a path with a relatively high latency in the available paths is determined as the target path, so as to improve user experience of a user with the high priority.

[0016] In a possible design, after the determining a target path for the service from m strict explicit paths based on the required latency, the method further includes: determining an alternate path for the service, where a latency of the alternate path is less than or equal to the required latency.

[0017] In the possible design, if a main path is faulty, a system can start the global protection mechanism, and smoothly switch the service to the alternate path that meets the service requirement for transmission, so as to enhance survivability of service transmission.

[0018] In a possible design, the method further includes: releasing a network slice on the target path after a target time period, where the target time period is a time period for using the target path.

[0019] In the possible design, after the user uses the target path, the network slice on the target path is released, so that the network slice is allocated to another user in time, and usage efficiency of the network slice is improved.

[0020] According to a second aspect, a path selection apparatus is provided, and the apparatus has a function of implementing any method provided in the first aspect. The function may be implemented by hardware, or may be implemented by hardware by executing corresponding software. The hardware or the software includes one or more units corresponding to the foregoing function.

[0021] According to a third aspect, a path selection apparatus is provided, including: a memory, a processor, and a communications bus, where the memory is configured to store a computer executable instruction, the processor and the memory are connected by using the communications bus, and the processor executes the computer executable instruction stored in the memory, so as to enable the apparatus to implement any method provided in the first aspect.

[0022] According to a fourth aspect, a computer readable storage medium is provided, including an instruction. When running on a computer, the instruction enables the computer to perform any method provided in the first aspect.

[0023] According to a fifth aspect, a computer program product that includes an instruction is provided. When running on a computer, the instruction enables the computer to perform any method provided in the first aspect.

[0024] For a technical effect brought by any design manner in the second aspect to the fifth aspect, refer to technical effects brought by different design manners in the first aspect. Details are not described herein again.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

FIG. 1 is a schematic architectural diagram of an overlay network in the prior art;
FIG. 2 is a schematic architectural diagram of a Spring network in the prior art;
FIG. 3 is a structural diagram of hardware of a server according to an embodiment of the present invention;
FIG. 4 is a flowchart of a path selection method according to an embodiment of the present invention;
FIG. 5 is a schematic diagram of a network slice type according to an embodiment of the present invention;
FIG. 6 is a schematic diagram illustrating a new network slice type according to an embodiment of the present invention;
FIG. 7 is a schematic diagram of a latency of a network slice according to an embodiment of the present invention;
FIG. 8 is a schematic diagram of constituting a path by network slices according to an embodiment of the present invention;
FIG. 9 is a schematic diagram of composition of a path selection apparatus according to an embodiment of the present invention; and
FIG. 10 is a schematic diagram of composition of another path selection apparatus according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0026] The method provided in the embodiments of the present invention may be applied to an overlay (overlay) network, a source packet routing in networking (Source Packet Routing in Networking, Spring for short), or the like. As shown in FIG. 1, the overlay network is a computer network established on another network (in FIG. 1, an example in which the overlay network is established on an underlay network is used for description). Nodes in the overlay network are connected to each other by using virtual links or logical links, and a path in the overlay network may be corresponding to a plurality of physical links in the underlay network. The overlay network may be connected to a software-defined networking (Software-Defined Networking, SDN for short) controller, and the SDN controller may be specifically an application-layer traffic optimization (Application-Layer Traffic Optimization, ALTO for short) server. The overlay network includes a plurality of overlay nodes (Overlay Node), and the overlay nodes (such as a, c, and z in the figure) may be terminal hosts. The underlay network includes a plurality of physical nodes (such as A, B, and C in the figure), and the physical nodes may be routers. One overlay node in the overlay network may be corresponding to at least one physical node in the underlay network. The SDN controller may control forwarding of a packet between the physical nodes. The SDN controller may exchange information with the plurality of overlay nodes, or may exchange information with the plurality of physical nodes.

[0027] As shown in FIG. 2, the Spring network includes an SDN controller and a plurality of physical nodes (such as A, B, and C in the figure). The SDN controller may be specifically a PCE server, and the physical nodes may be routers. The SDN controller may control forwarding of a packet between physical nodes, and the SDN controller exchanges information with only a source node (such as A in the figure).

[0028] Currently, services such as virtual reality (Virtual Reality, VR for short), augmented reality (Augmented Reality, AR for short), mixed reality (Mixed Reality, MR for short), automated driving, and Tactile Internet are all low-latency services. In a conventional Internet Protocol (Internet Protocol, IP for short) bearer network, various services share various resources in the network, packets of different priorities are stored in different queues, and scheduling is preferentially performed for a high-priority service, so that a low latency of the high-priority service in a case of heavy load can be ensured. However, because of a mechanism for sharing resources between services (for example, as mentioned in the background, a plurality of services share a path), it is difficult to meet transmission requirements of the foregoing services for deterministic low latencies. Based on this problem, an embodiment of the present invention provides a path selection method, so that a selected path can meet a requirement of a service for a deterministic low latency.

[0029] FIG. 3 is a structural diagram of hardware of a server (or a controller) 30 according to an embodiment of this application. The server 30 includes at least one processor 301, a communications bus 302, a memory 303, and at least one communications interface 304.

[0030] The processor 301 may be a central processing unit (Central Processing Unit, CPU for short), a microprocessor, an application-specific integrated circuit (Application-Specific Integrated Circuit, ASIC for short), or one or more integrated circuits configured to control execution of a program in the solution in this application.

[0031] The communications bus 302 may include a channel for transmitting information between the foregoing components.

[0032] The communications interface 304 is configured to communicate, by using any apparatus like a transceiver, with another device or a communications network, such as the Ethernet, a radio access network (Radio Access Network, RAN for short), or a wireless local area network (Wireless Local Area Network, WLAN for short).

[0033] The memory 303 may be a read-only memory (Read-Only Memory, ROM for short) or another type of static storage device capable of storing static information and instructions, or a random access memory (Random Access Memory, RAM for short) or another type of dynamic storage device capable of storing information and instructions; or may be an electrically erasable programmable read-only memory (Electrically Erasable Programmable Read-Only Memory, EEPROM for short), a compact disc read-only memory (Compact Disc Read-Only Memory, CD-ROM for short) or another compact disc storage, optical disc storage (including a compact disc, a laser disc, an optical disc, a digital universal disc, a Blu-ray disc, or the like), a magnetic disk storage medium or another magnetic storage device, or any other medium that can be configured to carry or store expected program code in a form of instructions or data structures and capable of being accessed by a computer, but this is not limited thereto. The memory may exist independently and be connected to the processor by using the bus. Alternatively, the memory may be integrated with the processor.

[0034] The memory 303 is configured to store application program code that executes the solution in this application, and the processor 301 controls execution of the solution in this application. The processor 301 is configured to execute the application program code stored in the memory 303, so as to implement the method provided in the following embodiment of the present invention.

[0035] During specific implementation, in an embodiment, the processor 301 may include one or more CPUs, for example, a CPU 0 and a CPU 1 in FIG. 3.

[0036] During specific implementation, in an embodiment, the server 30 may include a plurality of processors, for example, the processor 301 and a processor 308 in FIG. 3. Each of the processors may be a single-core (single-core) processor, or may be a multi-core (multi-CPU) processor. The processor herein may be one or more devices, circuits, and/or processing cores for processing data (for example, a computer program instruction).

[0037] During specific implementation, in an embodiment, the server 30 may further include an output device 305 and an input device 306. The output device 305 communicates with the processor 301, and may display information in a plurality of manners. For example, the output device 305 may be a liquid crystal display (Liquid Crystal Display, LCD for short), a light emitting diode (Light Emitting Diode, LED for short) display device, a cathode ray tube (Cathode Ray Tube, CRT for short) display device, or a projector (projector). The input device 306 communicates with the processor 301, and may receive an input of a user in a plurality of manners. For example, the input device 306 may be a mouse, a keyboard, a touchscreen device, or a sensing device.

[0038] An embodiment of the present invention provides a path selection method. As shown in FIG. 4, the method includes the following steps.

[0039] 401. Obtain a required latency of a service.

[0040] An execution body of this embodiment of the present invention may be a path selection apparatus. The apparatus may be a controller or a server, the controller may be an SDN controller, and the SDN controller may be specifically an ALTO server, a PCE server, or the like. In the following, an example in which the execution body is the SDN controller is used to describe this embodiment of the present invention.

[0041] Specifically, an application program may send a service request to the controller or the server by using an application programming interface (Application Programming Interface, API for short), where the service request may include information such as a service priority, a service flow identifier, a sending node and a receiving node of the service flow, the required latency of the service, and a time period for using a path.

[0042] For example, referring to FIG. 1 and FIG. 2, the sending node of the service flow may be A, and the receiving node may be Z.

[0043] 402. Determine a target path for the service from m strict explicit paths based on the required latency, where a latency of the target path is less than or equal to the required latency, all the m strict explicit paths are unallocated paths, any subpath of a first strict explicit path in the m strict explicit paths exists in only the first strict explicit path, the first strict explicit path is any path in the m strict explicit paths, and m is an integer greater than or equal to 1.

[0044] The target path determined for the service is used to transmit the service flow of the service.

[0045] For a meaning of the strict explicit path (Strict Explicit Path), refer to RFC4927.

[0046] It should be noted that, in this embodiment of the present invention, only one strict explicit path is allocated to a service, any two strict explicit paths do not include a same subpath, and any two strict explicit paths may be two unallocated strict explicit paths, two allocated strict explicit paths, or one allocated strict explicit path and one unallocated strict explicit path.

[0047] A subpath of a path refers to a path between two adjacent nodes in the path. For example, if a strict explicit path is A-B-C-D-E-Z, subpaths of the strict explicit path are A-B, B-C, C-D, D-E, and E-Z respectively. For another example, referring to Table 1 below, if a loose path is A-C-Z, subpaths of the loose path are A-C and C-Z.

[0048] It should be noted that, a sending node and a receiving node of any one of the m strict explicit paths are respectively the same as the sending node and the receiving node of the service flow of the service.

[0049] Optionally, before step 402, the method may further include the following steps.

[0050] (11) Determine a loose path corresponding to the service.

[0051] Specifically, the SDN controller may receive a path computation request, and determine, based on the path computation request, the loose path corresponding to the service.

[0052] For a meaning of the loose path (Loose Path), refer to RFC4927.

[0053] In this embodiment of the present invention, a node on the loose path corresponding to the service includes two transmission endpoints of the service flow of the service, and may further include one or more nodes between the two transmission endpoints. The one or more nodes may be specifically a node or nodes through which the service flow needs to pass when the service flow is transmitted between the two transmission endpoints.

[0054] For example, referring to FIG. 1, after the SDN controller receives a path computation request, because a link (that is, a path with a cross in the figure) between a-z in an overlay network is congested, a loose path of a service flow is determined as a-c-z. a is corresponding to A, c is corresponding to C, and z is corresponding to Z. Therefore, a loose path of a service flow in an underlay network is A-C-Z. A and Z are two transmission endpoints of the service flow, and Z is a node through which the service flow needs to pass when the service flow is transmitted between A and Z.

[0055] For example, referring to FIG. 2, after the SDN controller receives a path computation request, because a link (that is, a path with a cross in the figure) between C-D and D-Z in a Spring network is congested, a packet needs to be transmitted from a node C to a node O, and a loose path of a service flow in the Spring network is A-C-O-Z.

[0056] (12) Determine the m strict explicit paths based on unallocated network slices in network slices of n subpaths of the loose path, where a second strict explicit path in the m strict explicit paths includes n network slices, the n network slices are respectively corresponding to the n subpaths, a first network slice in the n network slices is an unallocated network slice in network slices of a subpath corresponding to the first network slice, the second strict explicit path is any path in the m strict explicit paths, the first network slice is any network slice in the n network slices, and n is an integer greater than or equal to 2.

[0057] For any one of the n subpaths, two endpoints of each network slice of the subpath are the same as two endpoints of the subpath, and each network slice of the subpath is a strict explicit path.

[0058] In this embodiment of the present invention, the SDN controller may store network slice information of each subpath of any loose path in the network, and the SDN controller may obtain a network slice of each subpath of the loose path based on the network slice information. Network slice information of a subpath may be obtained by performing network slice division on the subpath.

[0059] A principle for performing the network slice division on the subpath is as follows: Different network slices are not allowed to share a same physical link.

[0060] For example, referring to Table 1, if the loose path is A-C-Z, network slice information of the loose path A-C-Z may be specifically as follows:

Table 1

Network slice information of A-C-Z				
Subpath 1: A-C		Subpath 2: C-Z		
Slice 1: A-C (Allocated)	Slice 2: A-B-C (Reservable)	Slice 3: C-D-E-Z (Reservable)	Slice 4: C-F-G-Z (Reservable)	Slice 5: C-H-I-Z (Reservable)

[0061] Specifically, the network slice information may further include allocation information of a slice. "Reservable" indicates that the slice has not been allocated, and "Allocated" indicates that the slice has been allocated.

[0062] The allocated network slice may be represented as a 6-tuple: <a slice number, a subpath number, a latency value, a service flow identifier, a used time, and a remaining time>. A reservable network slice can be represented as a 3-tuple: <a slice number, a subpath number, and a latency value>.

[0063] Referring to Table 1, the slice 1 has been allocated, and other slices are not allocated. Therefore, three strict explicit paths may be determined based on the slice 2, the slice 3, the slice 4, and the slice 5, which are specifically: A-B-C-D-E-Z, A-B-C-F-G-Z, and A-B-C-H-I-Z.

[0064] Specifically, in this embodiment of the present invention, the Border Gateway Protocol-Link State (Border Gateway Protocol-Link State, BGP-LS for short) protocol may be used to define a new network slice type for the network slice obtained in this embodiment of the present invention. Referring to FIG. 5, a node NLRI (Node NLRI), a link NLRI (Link NLRI), IPv4 (Internet Protocol Version 4) topology prefix NLRI (IPv4 Topology Prefix NLRI), and IPv6 (Internet Protocol Version 6, Internet Protocol Version 6) topology prefix NLRI (IPv6 Topology Prefix NLRI) are four types of network layer reachability information (Network Layer Reachability Information, NLRI for short) in the BGP-LS, and network slice tunnel NLRI (Network Slice Tunnel NLRI) is a newly defined network slice type. Specifically, the network slice may be described by using the information shown in FIG. 6. A local tunnel endpoint descriptor (Local Tunnel Endpoint Descriptor) and a remote tunnel endpoint descriptor (Remote Tunnel Endpoint Descriptor) are used to describe two endpoints of the network slice, a network slice tunnel descriptor (Network Slice Tunnel Descriptor) is used to describe a path between a local endpoint to a remote endpoint, the description information may include a latency of the network slice. Further, the protocol ID information may be included in FIG. 6.

[0065] Specifically, a physical node may report the information about each network slice to the SDN controller by using the BGP-LS protocol, where the network slice information may include the information shown in FIG. 6. A BGP-LS Attribute (BGP-LS attribute) of the BGP-LS protocol may be extended: A new Link Attribute TLV (Link Attribute Type/Length/Value, Link Attribute Type/Length/Value) may be defined in the BGP-LS Attribute, and the latency of the network slice is carried in the new Link Attribute TLV and reported to the SDN controller. Specifically, a latency range that can be ensured by the network slice may be indicated by using a (min delay, max delay), and the latency of the network slice does not need to be periodically reported unless network topology changes.

[0066] In the overlay network, all physical nodes that can exchange information with the SDN controller may report the network slice information. In the Spring network, only a source node may report the network slice information.

[0067] Optionally, after step (12), the method may further include: determining a latency of each of the m strict explicit paths, where a latency of a third strict explicit path in the m strict explicit paths is a sum of latencies of all network slices that constitute the third strict explicit path, and the third strict explicit path is any path in the m strict explicit paths.

[0068] Any two paths in the first strict explicit path, the second strict explicit path, and the third strict explicit path may be a same path, or may be different paths.

[0069] A latency of a network slice includes a node latency, a link propagation latency, and a packet transmission latency of each node of the network slice.

[0070] Specifically, the node latency is a difference between an ingress physical layer (Physical Layer, PHY for short) device in the node and an egress device in the node; the link propagation latency is a ratio of a channel length to a transmission rate of an electromagnetic wave on the channel; and the packet transmission latency is a ratio of a data frame length to a sending rate.

[0071] Based on the example in Table 1, for the subpath 2, refer to FIG. 7. If each latency value is shown in Table 2, a latency of the slice 3 is 215 μs, a latency of the slice 4 is 370 μs, and a latency of the slice 5 is 1430 μs.

Table 2

Slice Number	Node latency		Link propagation latency + Packet transmission latency		
3	Node D	Node E	C-D	D-E	E-Z
	25 μs	30 μs	10 μs	100 μs	50 μs
4	Node F	Node G	C-F	F-G	G-Z
	30 μs	30 μs	10 μs	200 μs	100 μs
5	Node H	Node I	C-H	H-I	I-Z
	60 μs	20 μs	350 μs	500 μs	500 μs

[0072] Optionally, step 402 may specifically include: determining a priority of the service; determining available paths for the service from m strict explicit paths based on the required latency, where a latency of each of the available paths is less than or equal to the required latency; and determining the target path from the available paths based on the priority.

[0073] Specifically, an available path is a path that is in the m strict explicit paths and whose latency is less than or equal to the required latency. When the priority of the service is a high priority, a path with a relatively low latency in the available paths is determined as the target path, and specifically, a path that has a lowest latency in the available paths is determined as the target path; or when the priority of the service is a common priority, a path with a relatively high latency in the available paths is determined as the target path, so as to improve user experience of a user with the high priority.

[0074] When paths are allocated to a plurality of services with a same loose path, a path with a relatively low latency in strict explicit paths of the loose path may be allocated to a service with a relatively high priority, and a path with a relatively high latency may be allocated to a service with a relatively low priority.

[0075] Optionally, for reliability of transmission, after step 402, the method may further include: determining an alternate path for the service, where a latency of the alternate path is less than or equal to the required latency.

[0076] Based on the example shown in Table 1, only the network slice 2 is available for the subpath 1, and the network slice 3, the network slice 4, and the network slice 5 are available for the subpath 2. Referring to FIG. 8, a latency of a path 1 that includes a network slice 2 and a network slice 3 and a latency of a path 2 that includes the network slice 2 and a network slice 4 are less than the required latency of the service. Therefore, the path 1 may be determined as a main path of the service, and the path 2 may be determined as an alternate path of the service. If the main path is faulty, a system may start a global protection mechanism, and smoothly switch the service to the alternate path for transmission, where the alternate path meets a service requirement, so as to improve survivability of service transmission.

[0077] Optionally, the method may further include: releasing a network slice on the target path after a target time period, where the target time period is a time period for using the target path.

[0078] Specifically, after the user uses the target path, the network slice on the target path is released, so that the network slice is allocated to another user in time, and usage efficiency of the network slice is improved.

[0079] According to the method provided in this embodiment of the present invention, because any two paths do not include a same subpath and a path is allocated to only one service, a latency of each path is determined. When the path is determined for the service, the determined latency of the path is less than or equal to the required latency of the service, so that the path determined for the service can meet a latency requirement of the service, and an experience effect of the user is improved.

[0080] The foregoing has mainly described the solutions provided in the embodiments of this application from a perspective of the method. It may be understood that, to implement the foregoing functions, the path selection apparatus includes corresponding hardware structures and/or software modules for performing the functions. A person of ordinary skill in the art should be easily aware that, in combination with the examples described in the embodiments disclosed in this specification, units and algorithms steps may be implemented by hardware or a combination of hardware and computer software. Whether a function is performed by hardware or hardware driven by computer software depends on particular applications and design constraints of the technical solutions. A person skilled in the art may use different methods to implement the described functions for each particular application, but it should not be considered that the implementation goes beyond the scope of this application.

[0081] In this embodiment of this application, function modules of the path selection apparatus may be obtained through division based on the foregoing method examples. For example, each function module may be obtained through division based on each function, or two or more functions may be integrated into one processing module. The integrated module may be implemented in a form of hardware, or may be implemented in a form of a software function module. It should be noted that module division in the embodiments of this application is an example and is merely logical function division. During actual implementation, there may be another division manner.

[0082] For example, when function modules are divided based on corresponding functions, FIG. 9 shows a possible structure of a path selection apparatus 90 used in the foregoing embodiment. Referring to FIG. 9, the path selection apparatus 90 may include:

an obtaining unit 901, configured to obtain a required latency of a service; and
a first determining unit 902, configured to determine a target path for the service from m strict explicit paths based on the required latency, where a latency of the target path is less than or equal to the required latency, all the m strict explicit paths are unallocated paths, any subpath of a first strict explicit path in the m strict explicit paths exists in only the first strict explicit path, the first strict explicit path is any path in the m strict explicit paths, and m is an integer greater than or equal to 1.

[0083] Optionally, referring to FIG. 10, the apparatus 90 may further include:

a second determining unit 903, configured to determine a loose path corresponding to the service; where
the second determining unit 903 is further configured to determine the m strict explicit paths based on unallocated network slices in network slices of n subpaths of the loose path, where a second strict explicit path in the m strict explicit paths includes n network slices, the n network slices are respectively corresponding to the n subpaths, a first network slice in the n network slices is an unallocated network slice in network slices of a subpath corresponding to the first network slice, the second strict explicit path is any path in the m strict explicit paths, the first network slice is any network slice in the n network slices, and n is an integer greater than or equal to 2.

[0084] Optionally, the second determining unit 903 is further configured to determine a latency of each of the m strict explicit paths, where a latency of a third strict explicit path in the m strict explicit paths is a sum of latencies of all network slices that constitute the third strict explicit path, and the third strict explicit path is any path in the m strict explicit paths.

[0085] Optionally, the first determining unit 902 is specifically configured to:

determine a priority of the service;
determine available paths for the service from the m strict explicit paths based on the required latency, where a latency of each of the available paths is less than or equal to the required latency; and
determine the target path from the available paths based on the priority.

[0086] Optionally, the first determining unit 902 is further configured to:
determine an alternate path for the service, where a latency of the alternate path is less than or equal to the required latency.

[0087] Optionally, referring to FIG. 10, the apparatus 90 further includes:
a releasing unit 904, configured to release a network slice on the target path after a target time period, where the target time period is a time period for using the target path.

[0088] Each unit in the apparatus 90 is configured to perform the foregoing method. Therefore, for a beneficial effect of the apparatus 90, refer to a beneficial effect of the foregoing method, and details are not described herein again.

[0089] An embodiment of the present invention further provides a path selection apparatus. The apparatus includes: a memory, a processor, and a communications bus, where the memory is configured to store a computer executable instruction; the processor and the memory are connected by using the communications bus; and the processor executes the computer executable instruction stored in the memory, so as to enable the apparatus to implement the foregoing methods. Specifically, for a schematic structural diagram of the apparatus, refer to FIG. 3. The obtaining unit 901, the first determining unit 902, the second determining unit 903, and the releasing unit 904 may be collectively a processor 301.

[0090] An embodiment of the present invention further provides a computer readable storage medium, including an instruction. When running on a computer, the instruction enables the computer to perform the foregoing methods.

[0091] An embodiment of the present invention further provides a computer program product that includes an instruction. When running on a computer, the instruction enables the computer to perform the foregoing methods.

[0092] All or some of the foregoing embodiments may be implemented by using software, hardware, firmware, or any combination thereof. When a software program is used to implement the embodiments, the embodiments may be implemented completely or partially in a form of a computer program product. The computer program product includes one or more computer instructions. When the computer program instructions are loaded and executed on the computer, the procedure or functions according to the embodiments of this application are all or partially generated. The computer may be a general-purpose computer, a dedicated computer, a computer network, or other programmable apparatuses. The computer instructions may be stored in a computer-readable storage medium or may be transmitted from a computer-readable storage medium to another computer-readable storage medium. For example, the computer instructions may be transmitted from a website, computer, server, or data center to another website, computer, server, or data center in a wired (for example, a coaxial cable, an optical fiber, or a digital subscriber line (Digital Subscriber Line, DSL for short)) or wireless (for example, infrared, radio, and microwave, or the like) manner. The computer-readable storage medium may be any usable medium accessible by a computer, or a data storage device, such as a server or a data center, integrating one or more usable media. The usable medium may be a magnetic medium (for example, a floppy disk, a hard disk, or a magnetic tape), an optical medium (for example, a DVD), a semiconductor medium (for example, a solid-state drive (Solid-State Disk, SSD for short)), or the like.

[0093] Although this application is described with reference to the embodiments, in a process of implementing this application that claims protection, a person skilled in the art may understand and implement another variation of the disclosed embodiments by viewing the accompanying drawings, disclosed content, and the accompanying claims. In the claims, "comprising" (comprising) does not exclude another component or another step, and "a" or "one" does not exclude a case of multiple. A single processor or another unit may implement several functions enumerated in the claims. Some measures are recorded in dependent claims that are different from each other, but this does not mean that these measures cannot be combined to produce a better effect.

[0094] Although this application is described with reference to specific features and the embodiments thereof, obviously, various modifications and combinations may be made to them without departing from the scope of this application. Correspondingly, the specification and accompanying drawings are merely example description of this application defined by the accompanying claims, and is considered as any of or all modifications, variations, combinations that cover the scope of this application. Obviously, a person skilled in the art can make various modifications and variations to this application without departing from the scope of this application. This application is intended to cover these modifications and variations of this application provided that they fall within the scope of protection defined by the following claims.

Claims

1. A path selection method, wherein the method comprises:

obtaining a required latency of a service; and
determining a target path for the service from m strict explicit paths based on the required latency, wherein a latency of the target path is less than or equal to the required latency, any subpath of a first strict explicit path in the m strict explicit paths exists in only the first strict explicit path, the first strict explicit path is any path in the m strict explicit paths, and m is an integer greater than or equal to 1;
the method **characterized in that** all the m strict explicit paths are unallocated paths.

2. The method according to claim 1, wherein before the determining a target path for the service from m strict explicit paths based on the required latency, the method further comprises:

determining a loose path corresponding to the service; and
determining the m strict explicit paths based on unallocated network slices in network slices of n subpaths of the loose path, wherein a second strict explicit path in the m strict explicit paths comprises n network slices, the n network slices are respectively corresponding to the n subpaths, a first network slice in the n network slices is an unallocated network slice in network slices of a subpath corresponding to the first network slice, the second strict explicit path is any path in the m strict explicit paths, the first network slice is any network slice in the n network slices, and n is an integer greater than or equal to 2.

3. The method according to claim 2, wherein after the determining the m strict explicit paths based on unallocated network slices in network slices of n subpaths of the loose path, the method further comprises:
determining a latency of each of the m strict explicit paths, wherein a latency of a third strict explicit path in the m strict explicit paths is a sum of latencies of all network slices that constitute the third strict explicit path, and the third strict explicit path is any path in the m strict explicit paths.

4. The method according to any one of claims 1 to 3, wherein the determining a target path for the service from m strict explicit paths based on the required latency comprises:

determining a priority of the service;
determining available paths for the service from the m strict explicit paths based on the required latency, wherein a latency of each of the available paths is less than or equal to the required latency; and
determining the target path from the available paths based on the priority.

5. The method according to any one of claims 1 to 4, wherein after the determining a target path for the service from m strict explicit paths based on the required latency, the method further comprises:
determining an alternate path for the service, wherein a latency of the alternate path is less than or equal to the required latency.

6. The method according to any one of claims 1 to 5, wherein the method further comprises:
releasing a network slice on the target path after a target time period, wherein the target time period is a time period for using the target path.

7. A path selection apparatus (90), wherein the apparatus comprises:

an obtaining unit (901), configured to obtain a required latency of a service; and
a first determining unit (902), configured to determine a target path for the service from m strict explicit paths based on the required latency, wherein a latency of the target path is less than or equal to the required latency, any subpath of a first strict explicit path in the m strict explicit paths exists in only the first strict explicit path, the first strict explicit path is any path in the m strict explicit paths, and m is an integer greater than or equal to 1;
the determination of the target path for the service from m strict explicit paths based on the required latency by the first determining unit (902) is further **characterized in that** all the m strict explicit paths are unallocated paths.

8. The apparatus according to claim 7, wherein the apparatus further comprises:

a second determining unit (903), configured to determine a loose path corresponding to the service; wherein
the second determining unit (903) is further configured to determine the m strict explicit paths based on unallocated network slices in network slices of n subpaths of the loose path, wherein a second strict explicit path in the m strict explicit paths comprises n network slices, the n network slices are respectively corresponding to the n subpaths, a first network slice in the n network slices is an unallocated network slice in network slices of a subpath corresponding to the first network slice, the second strict explicit path is any path in the m strict explicit paths, the first network slice is any network slice in the n network slices, and n is an integer greater than or equal to 2.

9. The apparatus according to claim 8, wherein
the second determining unit (903) is further configured to determine a latency of each of the m strict explicit paths, wherein a latency of a third strict explicit path in the m strict explicit paths is a sum of latencies of all network slices that constitute the third strict explicit path, and the third strict explicit path is any path in the m strict explicit paths.

10. The apparatus according to any one of claims 7 to 9, wherein the first determining unit (902) is specifically configured to:

determine a priority of the service;
determine available paths for the service from the m strict explicit paths based on the required latency, wherein a latency of each of the available paths is less than or equal to the required latency; and
determine the target path from the available paths based on the priority.

11. The apparatus according to any one of claims 7 to 10, wherein the first determining unit (902) is further configured to:
determine an alternate path for the service, wherein a latency of the alternate path is less than or equal to the required latency.

12. The apparatus according to any one of claims 7 to 11, wherein the apparatus further comprises:
a releasing unit (904), configured to release a network slice on the target path after a target time period, wherein the target time period is a time period for using the target path.

13. The apparatus according to any one of claims 7 to 12, wherein the apparatus comprises a memory, a processor, and a communications bus; wherein the memory is configured to store a computer executable instruction, the processor and the memory are connected by using the communications bus, and the processor executes the computer executable instruction stored in the memory, so as to enable the apparatus to implement the method according to any one of claims 1 to 6.

Patentansprüche

1. Pfadauswahlverfahren, wobei das Verfahren Folgendes umfasst:

   Erhalten einer erforderlichen Latenz eines Dienstes; und
   Bestimmen eines Zielpfades für den Dienst aus m strikten expliziten Pfaden basierend auf der erforderlichen Latenz, wobei eine Latenz des Zielpfades kleiner oder gleich der erforderlichen Latenz ist, jeder Unterpfad eines ersten strikten expliziten Pfades in den m strikten expliziten Pfaden nur in dem ersten strikten expliziten Pfad existiert, der erste strikte explizite Pfad ein beliebiger Pfad in den m strikten expliziten Pfaden ist und m eine Ganzzahl größer oder gleich 1 ist;
   das Verfahren **dadurch gekennzeichnet ist, dass** alle m strikten expliziten Pfade nicht zugewiesene Pfade sind.

2. Verfahren gemäß Anspruch 1, wobei vor dem Bestimmen eines Zielpfades für den Dienst aus m strikten expliziten Pfaden basierend auf der erforderlichen Latenz das Verfahren ferner Folgendes umfasst:

   Bestimmen eines losen Pfades, der dem Dienst entspricht; und
   Bestimmen der m strikten expliziten Pfade basierend auf nicht zugewiesenen Netzwerkscheiben in Netzwerkscheiben von n Unterpfaden des losen Pfades,
   wobei ein zweiter strikter expliziter Pfad in den m strikten expliziten Pfaden n Netzwerkscheiben umfasst, die n Netzwerkscheiben jeweils den n Unterpfaden entsprechen, eine erste Netzwerkscheibe in den n Netzwerkscheiben eine nicht zugewiesene Netzwerkscheibe in Netzwerkscheiben eines Unterpfades ist, der der ersten Netzwerkscheibe entspricht, der zweite strikte explizite Pfad ein beliebiger Pfad in den m strikten expliziten Pfaden ist, die erste Netzwerkscheibe eine beliebige Netzwerkscheibe in den n Netzwerkscheiben ist, und n eine Ganzzahl größer oder gleich 2 ist.

3. Verfahren gemäß Anspruch 2, wobei nach dem Bestimmen der m strikten expliziten Pfade basierend auf nicht zugewiesenen Netzwerkscheiben in Netzwerkscheiben von n Unterpfaden des losen Pfades das Verfahren ferner Folgendes umfasst:
   Bestimmen einer Latenz jedes der m strikten expliziten Pfade, wobei eine Latenz eines dritten strikten expliziten Pfades in den m strikten expliziten Pfaden eine Summe der Latenzen aller Netzwerkscheiben ist, die den dritten strikten expliziten Pfad bilden, und der dritte strikte explizite Pfad ein beliebiger Pfad in den m strikten expliziten Pfaden ist.

4. Verfahren gemäß einem der Ansprüche 1 bis 3, wobei das Bestimmen eines Zielpfades für den Dienst aus m strikten expliziten Pfaden basierend auf der erforderlichen Latenz Folgendes umfasst:

   Bestimmen einer Priorität des Dienstes;
   Bestimmen von verfügbaren Pfaden für den Dienst aus den m strikten expliziten Pfaden basierend auf der erforderlichen Latenz, wobei eine Latenz jedes der verfügbaren Pfade kleiner oder gleich der erforderlichen Latenz ist; und
   Bestimmen des Zielpfades aus den verfügbaren Pfaden basierend auf der Priorität.

5. Verfahren gemäß einem der Ansprüche 1 bis 4, wobei nach dem Bestimmen eines Zielpfades für den Dienst aus m strikten expliziten Pfaden, basierend auf der erforderlichen Latenz, das Verfahren ferner Folgendes umfasst:
   Bestimmen eines alternativen Pfades für den Dienst, wobei eine Latenz des alternativen Pfades kleiner oder gleich der erforderlichen Latenz ist.

6. Verfahren gemäß einem der Ansprüche 1 bis 5, wobei das Verfahren ferner Folgendes umfasst:
   Freigeben einer Netzwerkscheibe auf dem Zielpfad nach einer Zielzeitspanne, wobei die Zielzeitspanne eine Zeitspanne zum Verwenden des Zielpfades ist.

7. Pfadauswahlvorrichtung (90), wobei die Vorrichtung Folgendes umfasst:

eine Erhaltungseinheit (901), die dazu ausgebildet ist, eine erforderliche Latenz eines Dienstes zu erhalten; und
eine erste Bestimmungseinheit (902), die dazu ausgebildet ist, einen Zielpfad für den Dienst aus m strikten expliziten Pfaden basierend auf der erforderlichen Latenz zu bestimmen, wobei eine Latenz des Zielpfades kleiner oder gleich der erforderlichen Latenz ist, jeder Unterpfad eines ersten strikten expliziten Pfades in den m strikten expliziten Pfaden nur in dem ersten strikten expliziten Pfad existiert, der erste strikte explizite Pfad ein beliebiger Pfad in den m strikten expliziten Pfaden ist und m eine Ganzzahl größer oder gleich 1 ist;
das Bestimmen des Zielpfades für den Dienst aus m strikten expliziten Pfaden basierend auf der erforderlichen Latenz durch die erste Bestimmungseinheit (902) ferner **dadurch gekennzeichnet ist, dass** alle m strikten expliziten Pfade nicht zugewiesene Pfade sind.

8. Vorrichtung gemäß Anspruch 7, wobei die Vorrichtung ferner Folgendes umfasst:

eine zweite Bestimmungseinheit (903), die dazu ausgebildet ist, einen losen Pfad zu bestimmen, der dem Dienst entspricht;
wobei die zweite Bestimmungseinheit (903) ferner dazu ausgebildet ist, die m strikten expliziten Pfade basierend auf nicht zugewiesenen Netzwerkscheiben in Netzwerkscheiben von n Unterpfaden des losen Pfades zu bestimmen,
wobei ein zweiter strikter expliziter Pfad in den m strikten expliziten Pfaden n Netzwerkscheiben umfasst, die n Netzwerkscheiben jeweils den n Unterpfaden entsprechen, eine erste Netzwerkscheibe in den n Netzwerkscheiben eine nicht zugewiesene Netzwerkscheibe in Netzwerkscheiben eines Unterpfades ist, der der ersten Netzwerkscheibe entspricht, der zweite strikte explizite Pfad ein beliebiger Pfad in den m strikten expliziten Pfaden ist, die erste Netzwerkscheibe eine beliebige Netzwerkscheibe in den n Netzwerkscheiben ist, und n eine Ganzzahl größer oder gleich 2 ist.

9. Vorrichtung gemäß Anspruch 8, wobei die zweite Bestimmungseinheit (903) ferner dazu ausgebildet ist, eine Latenz für jeden der m strikten expliziten Pfade zu bestimmen,
wobei eine Latenz eines dritten strikten expliziten Pfades in den m strikten expliziten Pfaden eine Summe der Latenzen aller Netzwerkscheiben ist, die den dritten strikten expliziten Pfad bilden, und der dritte strikte explizite Pfad ein beliebiger Pfad in den m strikten expliziten Pfaden ist.

10. Vorrichtung gemäß einem der Ansprüche 7 bis 9, wobei die erste Bestimmungseinheit (902) speziell für Folgendes ausgebildet ist:

Bestimmen einer Priorität des Dienstes;
Bestimmen von verfügbaren Pfaden für den Dienst aus den m strikten expliziten Pfaden basierend auf der erforderlichen Latenz, wobei eine Latenz jedes der verfügbaren Pfade kleiner oder gleich der erforderlichen Latenz ist; und
Bestimmen des Zielpfades aus den verfügbaren Pfaden basierend auf der Priorität.

11. Vorrichtung gemäß einem der Ansprüche 7 bis 10, wobei die erste Bestimmungseinheit (902) ferner für Folgendes ausgebildet ist:
Bestimmen eines alternativen Pfades für den Dienst, wobei eine Latenz des alternativen Pfades kleiner oder gleich der erforderlichen Latenz ist.

12. Vorrichtung gemäß einem der Ansprüche 7 bis 11, wobei die Vorrichtung ferner Folgendes umfasst:
eine Freigabeeinheit (904), die dazu ausgebildet ist, eine Netzwerkscheibe auf dem Zielpfad nach einer Zielzeitspanne freizugeben, wobei die Zielzeitspanne eine Zeitspanne zum Verwenden des Zielpfades ist.

13. Vorrichtung gemäß einem der Ansprüche 7 bis 12, wobei die Vorrichtung einen Speicher, einen Prozessor und einen Kommunikationsbus umfasst;
wobei der Speicher dazu ausgebildet ist, eine computerausführbare Anweisung zu speichern, der Prozessor und der Speicher über den Kommunikationsbus verbunden sind und der Prozessor die im Speicher gespeicherte computerausführbare Anweisung ausführt, so dass die Vorrichtung in der Lage ist, das Verfahren gemäß einem der Ansprüche 1 bis 6 zu implementieren.

Revendications

1. Procédé de sélection de chemin, le procédé comprenant :

    l'obtention d'une latence requise d'un service ; et
    la détermination d'un chemin cible pour le service parmi m chemins explicites stricts sur la base de la latence requise, dans lequel une latence du chemin cible est inférieure ou égale à la latence requise, tout sous-chemin d'un premier chemin explicite strict des m chemins explicites stricts existe uniquement dans le premier chemin explicite strict,
    le premier chemin explicite strict est tout chemin des m chemins explicites stricts et m est un entier supérieur ou égal à 1 ;
    le procédé étant **caractérisé en ce que** tous les m chemins explicites stricts sont des chemins non attribués.

2. Procédé selon la revendication 1, avant la détermination d'un chemin cible pour le service parmi m chemins explicites stricts sur la base de la latence requise, le procédé comprenant en outre :

    la détermination d'un chemin libre correspondant au service ; et
    la détermination des m chemins explicites stricts sur la base de tranches de réseau non attribuées parmi des tranches de réseau de n sous-chemins du chemin libre, dans lequel un deuxième chemin explicite strict des m chemins explicites stricts comprend n tranches de réseau, les n tranches de réseau correspondent respectivement aux n sous-chemins, une première tranche de réseau des n tranches de réseau est une tranche de réseau non attribuée parmi les tranches de réseau d'un sous-chemin correspondant à la première tranche de réseau, le deuxième chemin explicite strict est tout chemin des m chemins explicites stricts, la première tranche de réseau est toute tranche de réseau des n tranches de réseau et n est un entier supérieur ou égal à 2.

3. Procédé selon la revendication 2, après la détermination des m chemins explicites stricts sur la base de tranches de réseau non attribuées parmi des tranches de réseau de n sous-chemins du chemin libre, le procédé comprenant en outre :
    la détermination d'une latence de chacun des m chemins explicites stricts, dans lequel une latence d'un troisième chemin explicite strict des m chemins explicites stricts est une somme de latences de toutes les tranches de réseau qui constituent le troisième chemin explicite strict, et le troisième chemin explicite strict est tout chemin des m chemins explicites stricts.

4. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel la détermination d'un chemin cible pour le service parmi m chemins explicites stricts sur la base de la latence requise comprend :

    la détermination d'une priorité du service ;
    la détermination de chemins disponibles pour le service parmi les m chemins explicites stricts sur la base de la latence requise, dans lequel une latence de chacun des chemins disponibles est inférieure ou égale à la latence requise ; et
    la détermination du chemin cible parmi les chemins disponibles sur la base de la priorité.

5. Procédé selon l'une quelconque des revendications 1 à 4, après la détermination d'un chemin cible pour le service parmi m chemins explicites stricts sur la base de la latence requise, le procédé comprenant en outre :
    la détermination d'un chemin alternatif pour le service, dans lequel une latence du chemin alternatif est inférieure ou égale à la latence requise.

6. Procédé selon l'une quelconque des revendications 1 à 5, le procédé comprenant en outre :
    la libération d'une tranche de réseau sur le chemin cible après une période temporelle cible, dans lequel la période temporelle cible est une période temporelle d'utilisation du chemin cible.

7. Appareil de sélection de chemin (90), l'appareil comprenant :

    une unité d'obtention (901) configurée pour obtenir une latence requise d'un service ; et
    une première unité de détermination (902) configurée pour déterminer un chemin cible pour le service parmi m chemins explicites stricts sur la base de la latence requise, dans lequel une latence du chemin cible est inférieure ou égale à la latence requise, tout sous-chemin d'un premier chemin explicite strict des m chemins explicites stricts existe uniquement dans le premier chemin explicite strict, le premier chemin explicite strict est

tout chemin des m chemins explicites stricts et m est un entier supérieur ou égal à 1 ;
la détermination du chemin cible pour le service parmi m chemins explicites stricts sur la base de la latence requise par la première unité de détermination (902) étant en outre **caractérisée en ce que** tous les m chemins explicites stricts sont des chemins non attribués.

8. Appareil selon la revendication 7, l'appareil comprenant en outre :

une seconde unité de détermination (903) configurée pour déterminer un chemin libre correspondant au service, dans lequel
la seconde unité de détermination (903) est en outre configurée pour déterminer les m chemins explicites stricts sur la base de tranches de réseau non attribuées parmi des tranches de réseau de n sous-chemins du chemin libre, dans lequel un deuxième chemin explicite strict des m chemins explicites stricts comprend n tranches de réseau, les n tranches de réseau correspondent respectivement aux n sous-chemins, une première tranche de réseau des n tranches de réseau est une tranche de réseau non attribuée parmi les tranches de réseau d'un sous-chemin correspondant à la première tranche de réseau,
le deuxième chemin explicite strict est tout chemin des m chemins explicites stricts, la première tranche de réseau est toute tranche de réseau des n tranches de réseau et n est un entier supérieur ou égal à 2.

9. Appareil selon la revendication 8, dans lequel
la seconde unité de détermination (903) est en outre configurée pour déterminer une latence de chacun des m chemins explicites stricts, dans lequel une latence d'un troisième chemin explicite strict des m chemins explicites stricts est une somme de latences de toutes les tranches de réseau qui constituent le troisième chemin explicite strict, et le troisième chemin explicite strict est tout chemin des m chemins explicites stricts.

10. Appareil selon l'une quelconque des revendications 7 à 9, dans lequel la première unité de détermination (902) est spécifiquement configurée pour :

déterminer une priorité du service ;
déterminer des chemins disponibles pour le service parmi les m chemins explicites stricts sur la base de la latence requise, dans lequel une latence de chacun des chemins disponibles est inférieure ou égale à la latence requise ; et
déterminer le chemin cible parmi les chemins disponibles sur la base de la priorité.

11. Appareil selon l'une quelconque des revendications 7 à 10, dans lequel la première unité de détermination (902) est en outre configurée pour :
déterminer un chemin alternatif pour le service, dans lequel une latence du chemin alternatif est inférieure ou égale à la latence requise.

12. Appareil selon l'une quelconque des revendications 7 à 11, l'appareil comprenant en outre :
une unité de libération (904) configurée pour libérer une tranche de réseau sur le chemin cible après une période temporelle cible, dans lequel la période temporelle cible est une période temporelle d'utilisation du chemin cible.

13. Appareil selon l'une quelconque des revendications 7 à 12, l'appareil comprenant une mémoire, un processeur et un bus de communication ; dans lequel la mémoire est configurée pour stocker une instruction exécutable par ordinateur, le processeur et la mémoire sont connectés au moyen du bus de communication, et le processeur exécute l'instruction exécutable par ordinateur stockée dans la mémoire, de façon à permettre à l'appareil de mettre en oeuvre le procédé selon l'une quelconque des revendications 1 à 6.

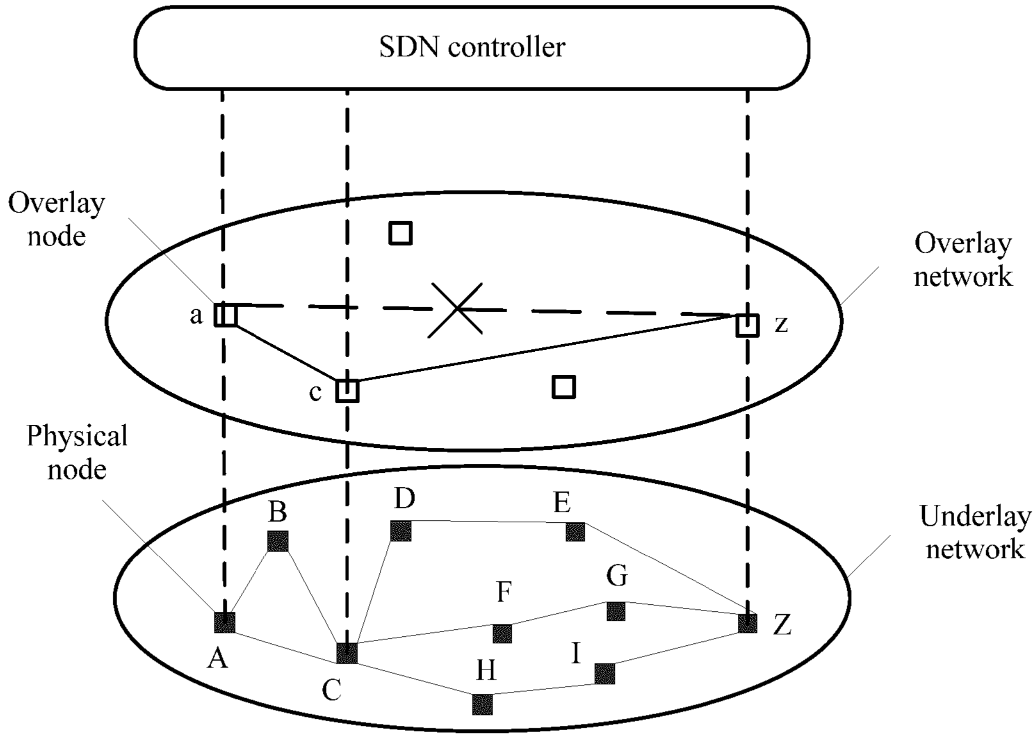
SDN controller
Overlay node
Overlay network
a
z
c
Physical node
Underlay network
B
D
E
G
F
A
C
H
I
Z

FIG. 1

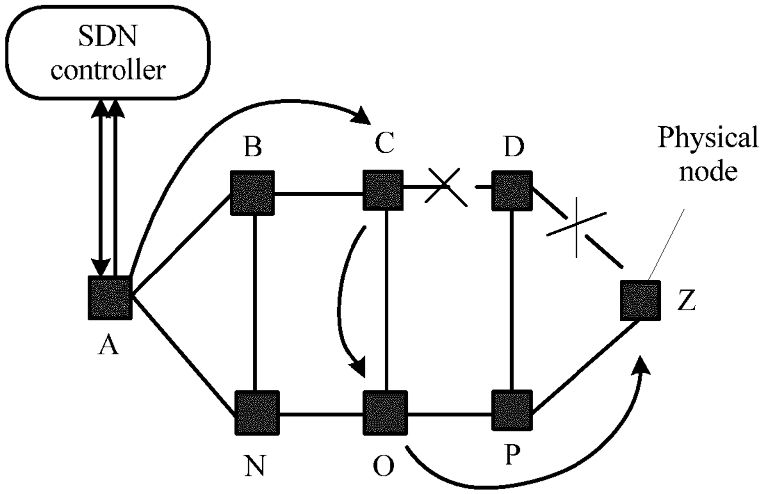
SDN controller
B
C
D
Physical node
A
Z
N
O
P

FIG. 2

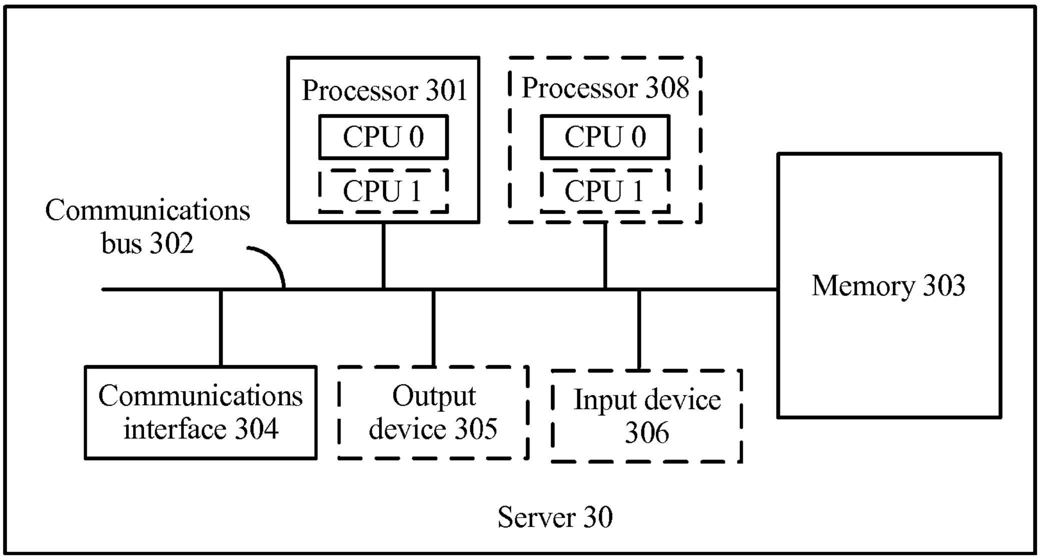
Processor 301
CPU 0
CPU 1
Processor 308
CPU 0
CPU 1
Communications bus 302
Memory 303
Communications interface 304
Output device 305
Input device 306
Server 30

FIG. 3

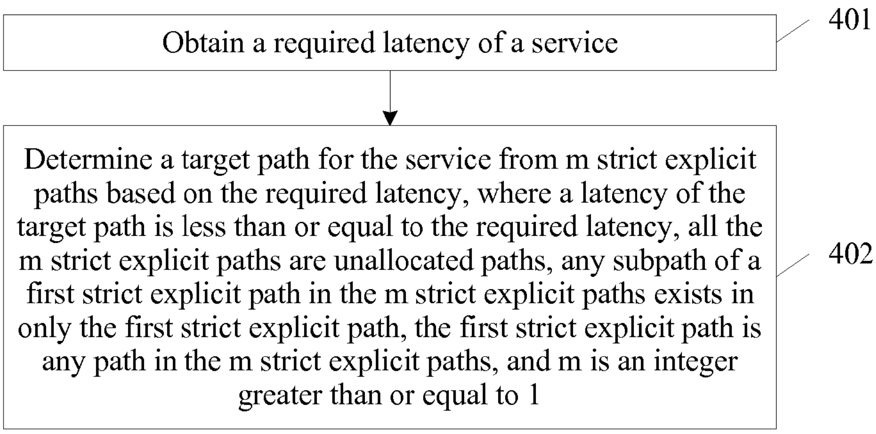
Obtain a required latency of a service
401
Determine a target path for the service from m strict explicit paths based on the required latency, where a latency of the target path is less than or equal to the required latency, all the m strict explicit paths are unallocated paths, any subpath of a first strict explicit path in the m strict explicit paths exists in only the first strict explicit path, the first strict explicit path is any path in the m strict explicit paths, and m is an integer greater than or equal to 1
402

FIG. 4

Type	NLRI Type
1	Node NLRI
2	Link NLRI
3	IPv4 Topology Prefix NLRI
4	IPv6 Topology Prefix NLRI
5	Network Slice Tunnel NLRI

FIG. 5

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+
|  Protocol ID  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|                          Description                          |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              Local tunnel endpoint descriptor               //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              Remote tunnel endpoint descriptor              //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                Network slice tunnel descriptor              //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

FIG. 6

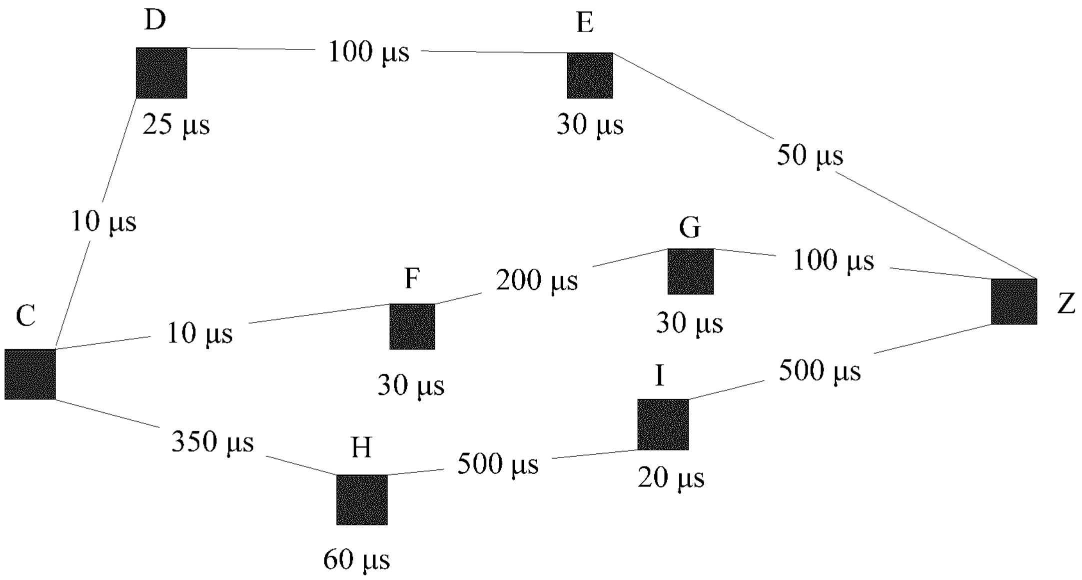

FIG. 7

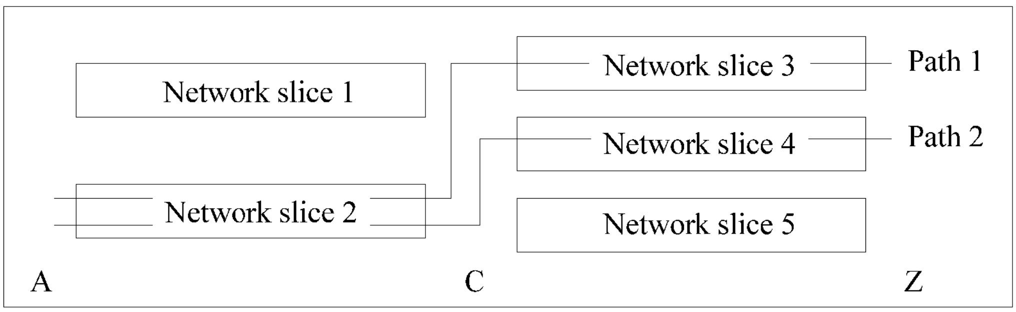

FIG. 8

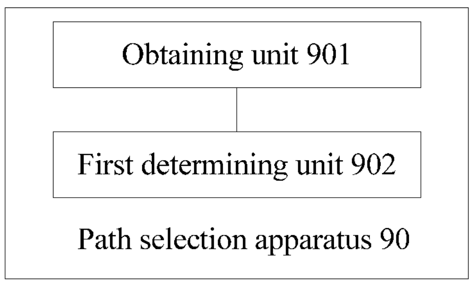

FIG. 9

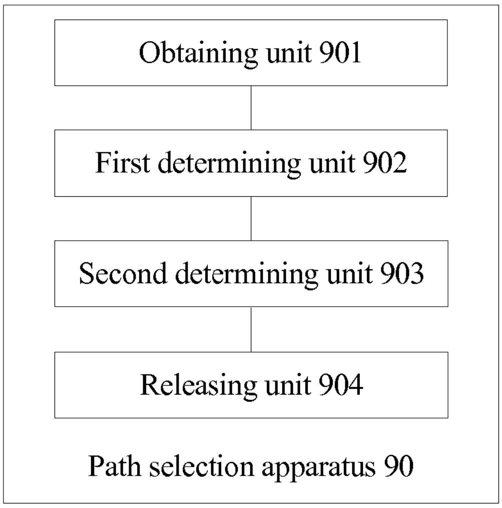
Obtaining unit 901
First determining unit 902
Second determining unit 903
Releasing unit 904
Path selection apparatus 90

FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20170064717 A1 **[0004]**

Non-patent literature cited in the description

- **Q. ZHAO ; D. DHDOY ; HUAWEI.** *Applicability of the Path Computation Element to Inter-Area and Inter-AS MPLS and GMPLS Traffic Engineering* **[0005]**
- **MAIZUMI H et al.** *PACKET FORWARDING ALONG AN EXPLICIT ROUTE USING THE UNUSED ADDRESS POOL ON A PACKET SWITCHING NETWORK,* 01 September 2007, 78-89 **[0005]**